





Title: Principles of Environmental Science, 9e

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#### New to This Edition —

Chapter 1 A new opening case study describes an important development in renewable energy on the Navajo Reservation in Arizona. In dramatic shift, the tribe has decided to move away from a reliance on dirty fossil fuels, and to turn instead to clean, renewable, solar energy. This shift will protect precious water resources, improve air quality for the whole region, reduce health risks from mining and burning coal, and help fight climate change for all of us. The chapter also has a new Exploring Science box on recent United Nations Sustainable Development Goals and the most current Human Development Index. We also have added text and a figure explaining planetary boundaries for critical resources and ecosystem services as well as how we may transgress crucial systems on which we all depend. We introduce a new feature in this chapter on Science and Citizenship with a focus on evidence and critical thinking.



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# New Features You'll See in Principles of Environmental Science, 9e

Chapter 2 opens with a case study on the Gulf of Mexico's "dead zone," which continues to grow in size despite the good intentions of many stake-holders. This example shows the importance of understanding principles of chemistry and biogeochemical cycles in ecology.
We expand on the discussion of trophic levels in biological communities with an essay how over-exploitation of Antarctic krill is disrupting the entire Antarctic Ocean food chain.

Chapter 3 provides new insights about the importance of the microbiome in chronic diseases and the possible effects of chronic exposure to antimicrobial compounds on our microbiological symbionts.

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Chapter 4 features a new opening case study on success of family planning in Thailand, where total fertility rates have fallen from 7 children per woman on average in 1974 to 1.5 in 2017. This dramatic change is linked to a new section later in the chapter describing how about half the world's countries are now at or below the replacement rate. The What Do You Think? essay on China's One-Child policy has been updated to reflect emerging worries about a birth dearth in China. Population data has been updated throughout the chapter, reflecting ongoing demographic changes in many regions of the world.

**Chapter 5** has a new opening case study on the growing threat of bark beetles in forest destruction and the frequency and cost of wild fires. This is a major case of ecosystem disturbance, state shift, and resource management policy, as well as a dramatic illustration of how climate shapes biomes. The Exploring Science essay in this chapter describes efforts to restore coral reefs, including breeding experiments that seek to create coral strains that can grow in warmer, more acidic sea water. Successful recovery of protected species under the Endangered Species Act is highlighted, along with the benefits of habitat protection.

Chapter 6 provides new data on the effects of palm oil plantations on biodiversity, including endangered orangutans, in the opening case study. Although many major food companies and oil traders have pledged to stop using or selling oil from recently deforested areas, compliance is difficult to monitor. In the meantime, orangs and people who try to protect them continue to be killed. Adding to this discussion, we have added a new Exploring Science essay on how we can use remote sensing to assess forest loss. We also have an updated What Can You Do? box with suggestions for individual actions to reduce forest impacts. Habitat loss isn't just a problem in other countries. the U.S. also has continued threats to natural areas. We address threats to the Alaska National Wildlife Refuge and to recently created national monuments in two new boxes for this edition.

**Chapter 7** opens with a new case study about introduction of crop varieties engineered to tolerate multiple herbicides,



and herbicide "cocktails" containing mixtures of different herbicides. This innovation is meant to combat pesticide resistance, but will it simply accelerate evolution of super weeds? And what are the potential human health effects, and the ecological consequences of ever greater exposure to these compounds? Fuel consumption in crop production is addressed in light of concern about global climate change, along with guestions about how we'll feed a growing human population in a changing world. Lowinput, sustainable farming is discussed as an alternative to modern industrial-scale farming methods.

Chapter 8 introduces environmental health with a new case study about the toxic floods that inundated Houston after Hurricane Harvey in 2017. The long-term effects of flooding thousands of chemical plants and superfund sites remains to be seen, but this is an excellent example of a growing threat from pollutants and synthetic chemicals, especially in vulnerable coastal cities. Our discussion of global health burdens is updated to reflect the threats of chronic conditions. Many new outbreaks of emergent diseases are noted. And we provide a new profile of important persistent organic pollutants (POPs).

**Chapter 9**'s focus on the causes and consequences climate change remain among the most important topics in the book. An extensive new section on the potential effects of a 2-degree average global temperature updates this discussion. Because no one can take action without hope, we emphasize the many, readily available strategies we can take to avoid these changes. A thorough examination of possible solutions, including goals and accomplishments of the Paris Accord, shows the many options that we have right now to solve our climate challenges. This chapter also contains updated discussions of basic climate processes and feedbacks.

10 Chapter 10 begins with a new case study about air quality in Delhi, India, which is now worse than that in Beijing, China. We amplify this case study with a new discussion in the text about health effects of air pollution, using Asia as an example. We also note that more than half of the 3 billion air pollution-related deaths worldwide are thought to be caused by indoor air. This is elaborated on in a new Exploring Science box about black carbon from combustion and its effects on health and climate.

Chapter 11 is a rare example in which
the opening case study hasn't changed
because water emergencies in California
remain a critical long-term problem.
Other topics, such as inexpensive
water purification techniques and water
recycling, also remain relevant and current.

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Chapter 12 introduces a new case study on the Pebble mine, a proposed giant strip mine at the headwaters of rivers flowing into Bristol Bay, Alaska. This mine, which had been blocked during the Obama administration, is now in play again with a



new regime in Washington. It threatens the largest remaining sockeye salmon fishery on the planet along with thousands of fish-related jobs and traditional native ways of life. It's an example of the many controversies about mining and mineral production. We update the discussion of induced seismicity with a new Exploring Science box about saltwater injection wells associated with oil and gas production in Oklahoma. Surface mining and coal sludge storage remain a serious problem in many places, so we've incorporated a new section in the text about these topics. And discussion of 2017 floods in South Asia which displaced more than 40 million people and killed at least 1,200, illustrate the dangers of global climate change for geological hazards.

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Chapter 13, which focuses on energy, is a focal chapter for climate solutions and sustainability. The opening case study on New York City's commitment to 80 percent reduction of greenhouse gas reductions becomes even more important with 2017 announcement that both the city and State of New York would divest \$5 billion in fossil fuel investments from their retirement funds (discussed in chapter 16). The chapter also reviews dramatic shifts in the price and efficiency of solar and wind power, which have made renewable energy cheaper than fossil fuels or nuclear even for existing facilities. An extensive new section on an energy transition explores future options for generating, storing, and transmitting energy. Drawing on the work of Jacobson and Delucchi, and Pawl Hawken's

recent Drawdown study, we show how sustainable energy could supply all our power needs.

14 Chapter 14 starts with a new opening case study about the huge problem of plastic trash accumulating in the oceans. In particular, the estimated 100 million tons of plastic circulating in a massive gyre the size of California just northwest of Hawaii is a threat both to fish and oceanic birds. A new What Do You Think? essay examines new Chinese policies that outlaw shipment of two dozen kinds of low-quality or dangerous solid waste threaten to upend waste disposal practices throughout the world.

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Chapter 15 opens with an important new case study on British Columbia's groundbreaking carbon tax. This revenueneutral use tax has been a tremendous environmental and economic success, and has provided millions to decrease corporate and personal taxes as well as to accomplish broader social goals while fostering an economic boom. This is an excellent and positive application of environmental economics. The section on cities and city planning in this chapter builds on the discussion in chapter 10 on New Delhi air pollution. We also return to the Human Development Index, and the problems of massive urban agglomerations in developing countries, some of which, like Lagos, Nigeria, could reach 100 million inhabitants by the end of this century. Valuation of nature is discussed in a New Exploring Science essay, which examines a new



estimate that raises the value of all global ecological services from \$33 trillion to as much as \$173 trillion, or more than twice the current global GDP.

Chapter 16 commences with a new case study on fossil fuel divestment pledges by New York City and New York State. Decarbonization of these huge economies is inspired by the damage done by Hurricane Sandy, which resulted in more than \$70 billion in damages. Even more notable than its divestment pledge, New York City is suing the world's five largest publicly traded oil companies for their role in climate

change. The divestment movement in colleges, universities and other entities represents more than \$6 trillion in assets. We support this discussion with a new section on policy making both at the individual and collective levels. We discuss the creation and implementation of some of our most important environmental laws, but we also examine how those rules and laws are now under attack by the current administration. We also have added an extensive new section on how colleges and universities can be powerful catalysts for change. Finally, we end with a review of the 2016 U.N. Sustainable Development Goals.